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# AIR QUALITY KENORA

## Annual Report 1975



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Ontario

Ministry  
of the  
Environment

L. F. Pitura  
Director  
Northwestern Region

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AIR QUALITY

KENORA

ANNUAL REPORT, 1975

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TECHNICAL SUPPORT SECTION  
NORTHWESTERN REGION  
ONTARIO MINISTRY OF THE ENVIRONMENT

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## SUMMARY

Ontario Ministry of the Environment investigations of Kenora air quality began in 1970, to assess effects of emissions from a sulphite pulp mill operated by the Ontario-Minnesota Pulp and Paper Company Limited. Assessment programs in subsequent years have included vegetation and snow sampling, and ambient air monitoring.

Vegetation in a small area south of the mill was injured by sulphur dioxide in 1974 and 1975. Evidence indicated that emissions from the mill were responsible for the damage.

Results of two snow sampling surveys revealed that contaminants containing calcium, magnesium and sulphate were emitted by the mill and deposited on the surrounding area. Evidence of bark char was also seen on and below the snow surface to the north, east and south of the pulp mill area.

Dustfall criteria were often exceeded, but only a portion of total dustfall measured was attributed to contaminants discharged from the mill. Suspended particulate levels were below the Ontario criterion. Very limited data on sulphation rates indicated that levels of sulphur-containing atmospheric pollutants have declined in recent years.

A source monitoring survey in late July showed that suspended particulate levels were generally satisfactory but that sulphur dioxide concentrations exceeded the Ontario standard for brief periods downwind of the pulp mill.

## INTRODUCTION

The principal industrial source of air pollution in Kenora is a 200 ton-per-day magnesium-base sulphite pulp mill operated by the Ontario-Minnesota Pulp and Paper Company Limited. Sulphur dioxide is the main atmospheric emission from pulp mills using the sulphite process. Secondary contaminants may include gaseous and particulate matter from power boilers, depending on the type and quantity of fuels burned.

The first air quality investigation in Kenora was carried out by Ontario Ministry of the Environment in 1970 in response to complaints of alleged air pollution injury to vegetation on residential properties. Air monitoring began in late 1972 with the selection of two sites for sulphation rate measurements. Four dustfall jars were added in late 1973. Snow sampling was undertaken in early 1974 and, later that summer, further complaints of vegetation damage were investigated. An expanded snow sampling survey was conducted in early 1975, followed by another vegetation assessment survey in July. Measurements of atmospheric concentrations of sulphur dioxide and suspended particulate were made during July and August by a mobile monitoring unit provided by Air Resources Branch, Toronto. The Kenora air monitoring network was further expanded in 1975 with the addition of a high volume sampler for suspended particulate and two new sulphation measurement sites. Station locations were adjusted to provide better estimates of the pollutants under investigation.

## VEGETATION ASSESSMENT

Complaints to Ministry of the Environment concerning air pollution injury to Kenora vegetation extend back to 1969. A brief vegetation survey in 1970 failed to disclose evidence of adverse effects, but sample points were too far (more than 400 metres) from the alleged source to detect any significant difference from normal background conditions.

Seven complaints of vegetation damage were investigated in July, 1974. Typical symptoms of acute sulphur dioxide injury were noted on foliage of a wide range of plant species, including trees, shrubs, flowers and vegetable crops. About 1.8 hectares of vegetation, centred 150 metres south of the mill, were damaged by the fumigation. Injury symptoms, chemical analysis results and meteorological data all confirmed that sulphur dioxide was the cause of the fumigation effects and that the sulphite mill was the source.

A routine inspection of vegetation around the mill in late July, 1975, indicated that sulphur dioxide damage had occurred in a small area (<0.5 ha) about 100 m south of the source. It was estimated that this injury had followed a fumigation about a month earlier.

#### SNOW SAMPLING

Three sets of snow samples collected in January, February and March, 1974, from 16 sites in the vicinity of the Ontario-Minnesota sulphite mill demonstrated the presence of moderately elevated levels of calcium and sulphate and slightly elevated concentrations of magnesium. These findings were confirmed by a second survey in January and March, 1975, results of which appeared in an earlier report. Both calcium and sulphate showed pronounced gradients of decreasing concentrations with increasing distance from the mill. Sulphate levels were sufficiently high to suggest that contamination had resulted from deposition of a sulphur-containing substance in particulate or aerosol form. The similarity in the distribution pattern of sulphate and magnesium in snow suggested that these pollutants were associated with one another. The distribution pattern of calcium and pH near the mill were also similar, indicating that the latter may have been attributed to the former. The presence of calcium contamination was thought to arise from lignite coal ash emitted to the atmosphere from power boiler operations.

Black particulate matter was observed on snow surfaces up to 2000 m north and east of the sulphite mill. The concentration of this material declined as distance from the mill increased. A similar substance was noted in grey-coloured bands below the snow surface at sample points closest to the mill to the north, east and south. This contaminant was tentatively identified as char emitted by bark-burning boilers.

## AIR MONITORING

### (a) Dustfall

Dustfall is one of the most visible classes of air pollutants. It comprises particulate matter which settles out from the atmosphere under the influence of gravity. It is measured by exposing open-top vessels for 30 days and weighing the collected matter. Results are expressed in tons per square mile per month.

Kenora sampling sites for dustfall are shown in Figure 1, and the monthly results for 1975 are summarized in Table 1. Ontario's monthly criterion was frequently exceeded, particularly at station 61007 (Melick and Ninth). The criterion for average annual dustfall was also exceeded at three of the four monitoring points. Annual averages for both 1974 and 1975 are plotted on Figure 2. Dustfall was highest at the station closest to the mill. Average dustfall at all sites declined from 1974 to 1975. The substance most consistently observed in dustfall jars was black particulate, identified as char emitted from bark-burning boilers. Bark char and other particulate matter emitted by the mill did not, however, account for all the dustfall collected. A substantial, but undetermined, quantity could be attributed to re-entrainment of ground-level dust blown up by strong winds or vehicular traffic.

The average dustfall for the November-December period in 1973 and 1974 was 19 tons. During the same period in 1975, when the mill was closed by strike, average dustfall at all stations was



only 12 tons. This decrease may have reflected benefits from mill closure, but may also have resulted from natural variation.

#### (b) Suspended Particulate

Suspended particulate constitutes particulate matter of small size which remains in the atmosphere for extended periods. A known volume of air is drawn through pre-weighed glass fibre filters for 24-hour periods and the filters are then re-weighed to determine the quantity of dust collected. Results are expressed in micrograms per cubic metre of air ( $\mu\text{g}/\text{m}^3$ ).

Just over five months of data for 1975 are available for the single monitoring station in Kenora (Table 2). Results for this period, while not necessarily representative for the long term, were satisfactory and all values were well below the provincial 24-hour criterion of  $120 \mu\text{g}/\text{m}^3$ .

#### (c) Sulphation

Sulphation rate is measured by exposing lead dioxide plates to the air for 30-day periods. Lead dioxide reacts with sulphur compounds in the atmosphere to form lead sulphate. Results are expressed in milligrams of sulphur dioxide per hundred square centimetres per day ( $\text{mg SO}_2/100 \text{ cm}^2/\text{day}$ ). Although several sulphur compounds may react with lead dioxide, sulphur dioxide is considered to be the only potential reactive pollutant in the centre of Kenora.

Sulphation monitoring sites are indicated in Figure 1 and results are presented in Table 1. At station 61002, sulphation rates have always been very low since monitoring began in December, 1972. At the closest site, station 61003, the average sulphation rate was 0.17 (maximum 0.63) in 1973, 0.13 (0.69) in 1974 and 0.07 (0.19) in 1975, indicating a trend of improvement over the past three years. All values were below the current Ontario criterion of 0.70 mg.

#### (d) Source Monitoring Survey

An air quality survey was carried out in late July--early August, 1975, by a mobile monitoring unit from Air Resources Branch, Toronto. Depending on wind direction and accessibility, monitoring usually began downwind of the source under investigation at the point of expected highest pollutant concentration. Measurements of gaseous pollutants (sulphur dioxide in this case) were then made for periods of at least 30 minutes. Suspended particulate concentrations were determined using standard high volume samplers operated for 24-hour periods. Exposed filters were analysed for calcium content. Monitoring locations are shown in Figure 3.

##### (i) Suspended Particulates

Total suspended particulate and calcium concentrations recorded from July 31 to August 5 are given in Table 4. All but two of the 28 values were below the Ontario standard of  $100 \mu\text{g}/\text{m}^3$ . Calcium levels generally increased with increasing values for total particulate loading, suggesting that the mill was a source of calcium emissions. For the three sites downwind of the mill for most of the survey period, average suspended particulate decreased with increasing distance.

##### (ii) Sulphur Dioxide

Because of difficulties in positioning the monitoring van downwind of the sulphite mill during digester blow-down periods, only one hour of measurements were made during the survey (Table 3). At two sites (Figure 3) north of the mill, values above the 30-minute standard (0.3 ppm) were recorded for two half-hour periods on July 30 and July 31.

## ACKNOWLEDGEMENTS

Contributions and assistance from the following agencies is gratefully acknowledged:

- Regional Laboratory, Northwestern Region, for dustfall and suspended particulate weight determinations and for chemical analysis of snow meltwater samples.
- Industrial Abatement Section, Kenora District Office, for operation of the Kenora air monitoring network and for assistance with snow sampling.
- Air Quality Laboratory Section, Laboratory Branch, for preparing and analysing sulphation plates and for chemical analysis of vegetation samples.
- Instrumentation Development and Monitoring Unit, Air Resources Branch, for conducting the special air quality survey.
- Phytotoxicology Section, Air Resources Branch, for technical advice and for processing vegetation samples.

TABLE 1. Dustfall levels and sulphation rates, Kenora, 1975.

Station	Location	Distance(metres) and direction from source*	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Dustfall (tons/square mile/30 days)															
61003	Fourth/Main	140 S	19		<u>21</u> <sup>+</sup>	15	<u>22</u>	<u>26</u>	4	10	<u>32</u>	11	19	2	<u>16</u>
61005	Melick/Tenth	395 NNW	10	10	16	12	15	16	<u>27</u>	12	<u>34</u>				<u>17</u>
61006	Matheson/Fourth	395 SE	7	16	9	7	14	-	-	12	10	-	<u>21</u>	11	12
61007	Melick/Ninth	225 NE	17	10	<u>25</u>	<u>22</u>	<u>26</u>	<u>33</u>	<u>38</u>	<u>35</u>	<u>23</u>	14	<u>21</u>	1	<u>22</u>
61008	Melick/Eleventh	475 N										7	19	1	
Sulphation rate (mg SO <sub>3</sub> /100 cm <sup>2</sup> /day)															
61002	Firehall/Second	410 S	.06	.05	.06	.02	.01	.03	.05	.03	.03				.04
61003	Fourth/Main	140 S	.08	.05	.09	.04	.03	.05	.19	.03	.08	.15	.03	.04	.07
61006	Matheson/Fourth	395 SE										.03	.03	-	
61007	Melick/Ninth	225 NE										.03	.03	.04	
61008	Melick/Eleventh	475 N										.07	.03	.03	

\*Source arbitrarily designated as vomit stack, Ontario-Minnesota Pulp and Paper Company Limited sulphite mill.

<sup>+</sup>Values exceeding criteria of 20 (monthly) or 13 (annual average) are underlined.

TABLE 2. Suspended particulate, station 61003, Kenora, 1975.

Date		Suspended particulate ( $\mu\text{g}/\text{m}^3$ )	Date		Suspended particulate ( $\mu\text{g}/\text{m}^3$ )
July	23	22	October	3	-
	29	75		9	46
August	4	-		15	13
	10	26		21	28
	16	14		27	-
	22	18	November	2	-
	28	24		8	20
September	3	17		14	25
	9	28		20	7
	15	37		26	7
	21	-	December	2	10
	27	-		8	14
				14	14
				20	-
				26	10

TABLE 3. Sulphur dioxide concentrations monitored downwind of Ontario-Minnesota sulphite mill, Kenora, July 30-31, 1975.

Site	Distance(metres) and direction from source*	Date	Period monitored	Concentrations(ppm)		
				30-minute average	Peaks	
					Min.	Max.
6	320 N	July 30	16:52-17:22	0.40	0.19	1.75
7	505 NNE	July 31	10:30-11:00	0.40	0.17	1.77

\*Source arbitrarily designated as vomit stack, Ontario-Minnesota Pulp and Paper Company Limited sulphite mill.

TABLE 4. Suspended particulate levels from source monitoring survey, Kenora, July-August, 1975.

Site	Distance(metres) and direction from source*	Date	Suspended particulate ( $\mu\text{g}/\text{m}^3$ )	Calcium ( $\mu\text{g}/\text{m}^3$ )
1	335 N	July 31	77	4.6
		August 1	66	4.3
		2	19	3.9
		3	2	1.5
		4	16	2.9
		5	7	2.1
		Average	31	3.2
2	320 NNE	July 31	125	14.8
		August 1	47	2.8
		2	47	2.8
		3	40	2.3
		4	34	2.9
		5	18	2.4
		Average	52	4.7
3	260 NE	July 31	178	17.4
		August 1	73	6.6
		2	26	2.6
		3	18	2.4
		4	25	3.6
		5	8	2.2
		Average	55	5.8
4	140 SSE	July 31	74	2.4
		August 1	49	1.3
		2	23	1.3
		3	13	1.3
		4	13	1.2
		5	36	1.9
		Average	35	1.6
5	320 ENE	August 2	33	3.1
		3	28	3.2
		4	25	3.5
		5	9	2.3

\*Source arbitrarily designated as vomit stack, Ontario-Minnesota Pulp and Paper Company Limited sulphite mill.

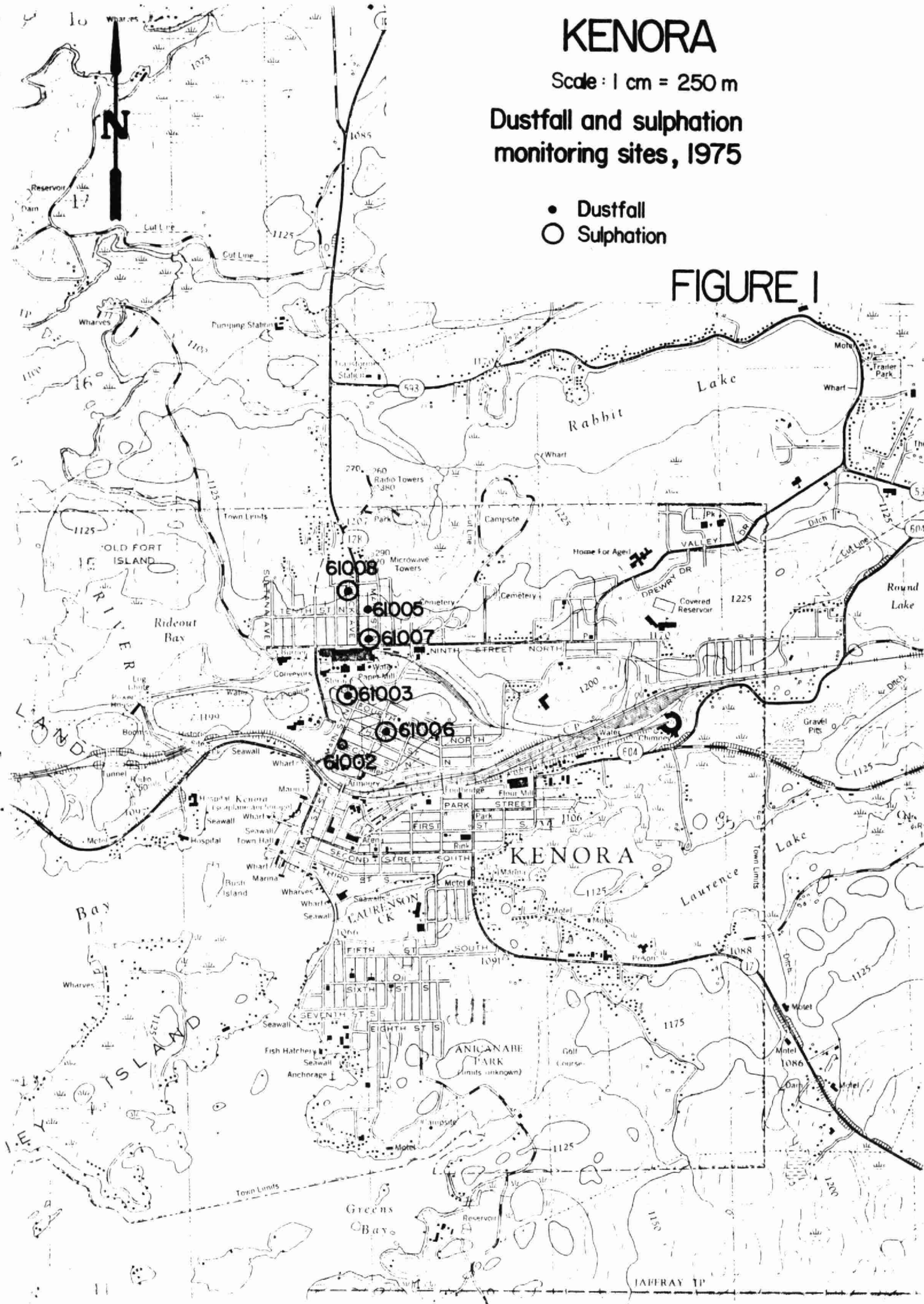
# KENORA

Scale: 1 cm = 250 m

Dustfall and sulphation  
monitoring sites, 1975

- Dustfall
- Sulphation

FIGURE 1



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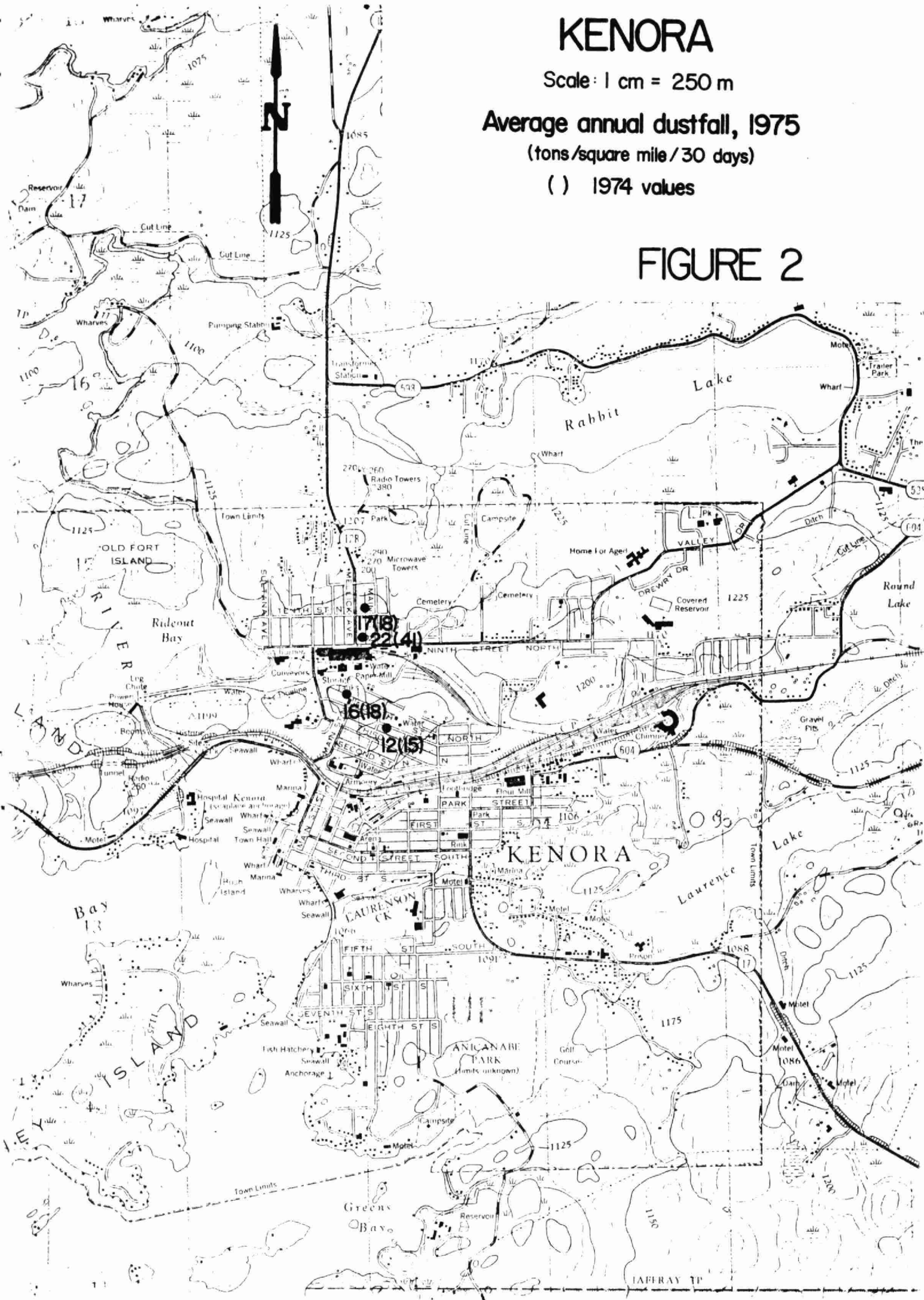
Scale: 1 cm = 250 m

**Average annual dustfall, 1975**

(tons/square mile / 30 days)

( ) 1974 values

FIGURE 2





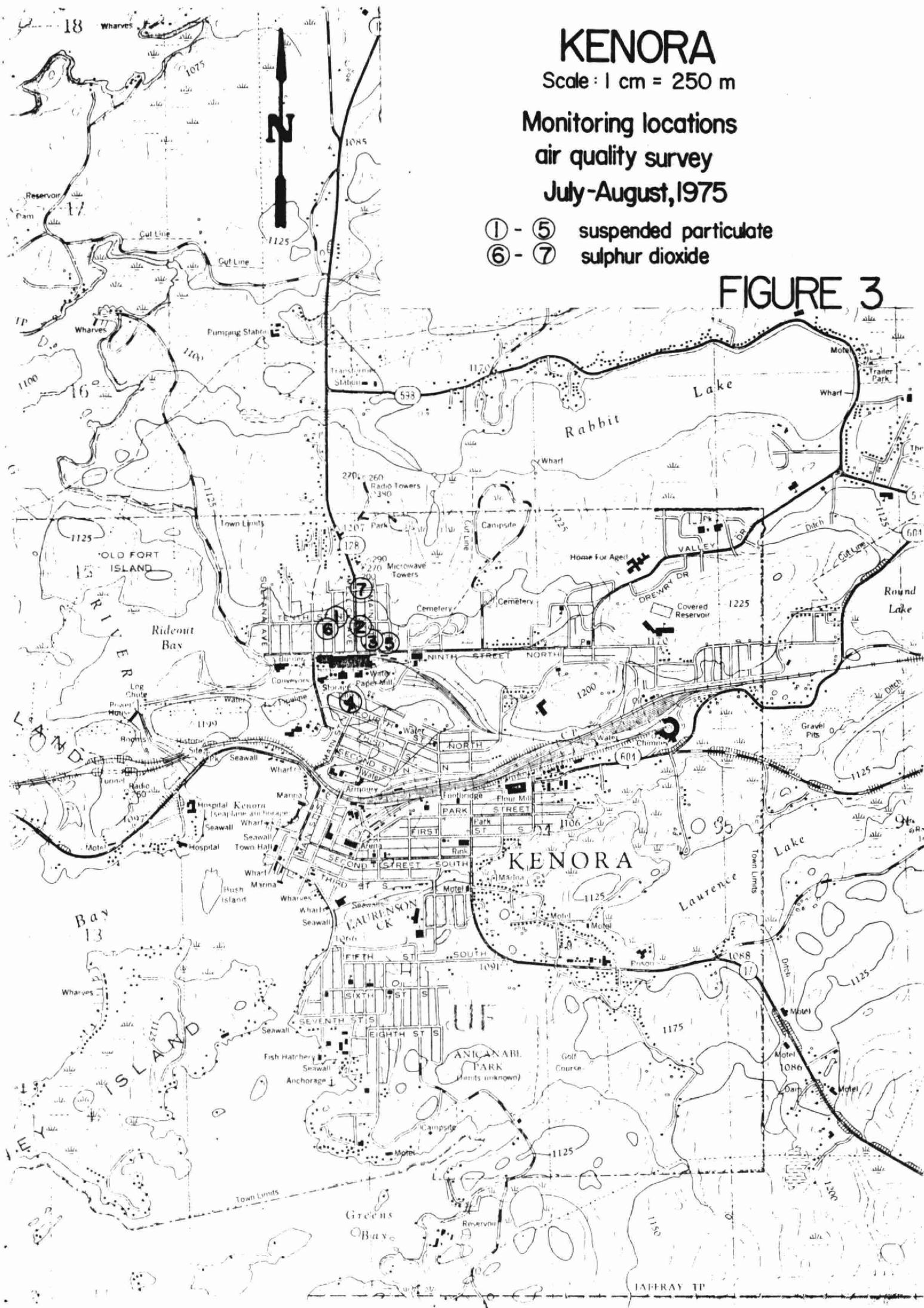
# KENORA

Scale : 1 cm = 250 m

Monitoring locations  
air quality survey  
July-August, 1975

- ① - ⑤ suspended particulate  
⑥ - ⑦ sulphur dioxide

FIGURE 3



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[illegible]